## REMARKS

Claims 1-2 and 6 were pending in the application. In the Office Action mailed December 22, 2009, claims 1 and 2 are rejected, and claim 6 was previously withdrawn due to a restriction requirement. In the instant Amendment, claims 1 and 2 have been amended and new claims 7-10 have been added.

Claims 1 and 2 have been amended to recite that the steel has a strength of at least 1049 $N/mm^2$. Support for this amendment is found at, *e.g.*, p. 16, Table 4, Example S2 of the specification. Claims 1 and 2 have also been amended to recite that the ferritic structure is strengthened by, in addition to TiC and/or NbC precipitates without adding Mg, Mn and C. Support for this amendment is found at, *e.g.*, p. 4, l. 31 through p. 5, l. 4; and p. 5 ll. 17 to 30. Claims 1 and 2 have further been amended to incorporate the process for production of the claimed steel. The amendment finds support at, *e.g.*, p. 10, l. 1 through p. 11, l. 13; and Tables 3 and 4; *see* also Exhibit A: Reference Figure 1.

New claims 7-10 correspond to the cancelled claims 3 and 5, amended into independent form.

Upon entry of the instant Amendment, claims 1, 2, 6 and 7-10 will be pending in the application.

No new matter has been introduced. Entry of the foregoing amendments and consideration of the following remarks are respectfully requested.

### Rejection under 35 U.S.C. § 103(a)

Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Japanese Publication No. 2002-180188 to Okada et al. ("JP '188"), Japan No. 2002-180189 to Okada et al. ("JP '189"), Japan No. 2002-180190 to Okada et al. ("JP '190") in view of European Publication No. 0320003 to Tomita et al. ("EP '003") for the reasons set forth on pages 3 to 4 of the Office Action.

Claims 1 and 2, as amended, are directed to steel sheets having a ferritic structure and having a tensile strength of at least 1049 $N/mm^2$. The present inventors have discovered that ductility and hole expandability are remarkably improved by sufficiently forming a ferrite structure and by suppressing generation of hard structures such as martensite and bainite. The present inventors have also discovered that hole expandability can be improved even with high strength, by precipitation strengthening of TiC and/or NbC and by controlling the

ranges of Mn and C components (*see*, the specification at, *e.g.*, p. 4, ll. 15-28; p. 6, ll. 12-29; and p. 8, ll. 17-20).

For example, the present inventors have discovered that when the C content is too low, the desired strength can not be obtained, and when the C content is too high, ductility is deteriorated. With respect to Mn, the inventors have discovered that the Mn content must be as small as possible (since it deteriorates elongation) but must still be large enough that the strength can be secured. Ti (and/or Nb) is effective for securing strength through precipitation of TiC, but when a large amount of Ti is added, precipitation of TiC proceeds during heating for hot rolling (*see*, the specification at, *e.g.*, p. 4, l. 31 through p. 5, l. 4; p. 5, ll. 17-30; and p. 6, ll. 12-29).

The present inventors have thus derived relational formulae based on the effects of precipitation hardening of TiC and the effects of structure strengthening by Mn and C on steel properties. That is, in order to obtain the above-discussed effects, the contents of the alloy elements of the steel must be controlled so that the formulae <1> to <3> or <1>' to <3>' are satisfied, thereby strengthening the ferrite structure by Ti and/or Nb carbide precipitation, Mn and C.

Furthermore, the claimed hot rolled steel sheet must be produced by the following steps: finishing hot rolling at a rolling end temperature from an $Ar_3$ transformation point to 950°C; cooling the steel sheet to 650 to 800°C at a cooling rate of at least 20°C/sec; air cooling then the steel sheet for 0.5 to 0.8 seconds; further cooling the steel sheet to 300 to 600°C at a cooling rate of at least 20°C/sec; and coiling the steel sheet (*see*, the specification at, *e.g.*, p. 10, l. 1 through p. 11, l. 13).

In particular, it is critical in achieving consistent production of steel sheets having a tensile strength of at least 1049 $N/mm^2$ by controlling the air cooling time to be 0.8 seconds or less. Applicants submit herewith Exhibit A: Reference Figure 1, which shows tensile strength of the inventive steels and the comparative steels of the present application as a function of air cooling time. As can be seen from the figure, when the air cooling time is within 0.8 seconds, steel sheets having a tensile strength of at least 1049 $N/mm^2$ can be consistently obtained. However, when the air cooling time exceeds 0.8 seconds, the tensile strength fluctuates greatly and a tensile strength of at least 1049 $N/mm^2$ can not be consistently obtained, even if the composition and formulae <1> to <3> or <1>' to <3>' of the present invention are satisfied. In addition, as the comparative examples of the present application show, a tensile strength of at least 1049 $N/mm^2$ cannot be obtained even if the air

cooling time is within 0.8 seconds because their compositions are outside the claimed ranges or the requirements of formulae <1> to <3> or <1>' to <3>'.

JP '188 relates to a high strength hot rolled steel sheet having excellent hole expandability and ductility containing, in mass %, C : 0.01 to 0.08%, Si: 0.3 to 1.5%, Mn: 0.5 to 2.5%, P: 0.03% or below, S: 0.005% or below, and at least one of Ti: 0.01 to 0.2% and Nb: 0.01 to 0.04%, the balance consisting of iron and unavoidable impurities; and in which the contents of C, Si, Mn, Ti and Nb satisfy the inequality of 115 ≤ (917-480[C%]+100[Si%]-100[Mn%]-790x([Ti%]+[Nb%]/2)0.05) ≤ 235 is hot-rolled into a steel sheet having a duplex steel structure of ≥ 80% ferrite, and the balance bainite.

JP '189 relates to a high strength hot rolled steel sheet having excellent hole expandability and ductility containing, in mass %, C : 0.01 to 0.08%, Si: 0.3 to 1.5%, Mn: 0.5 to 2.5%, P: 0.03% or below, S: 0.005% or below, and at least one of Ti: 0.01 to 0.2% and Nb: 0.01 to 0.04%, the balance consisting of iron and unavoidable impurities is hot-rolled into a steel sheet in which crystal grains satisfying the ratio of minor axis/major axis (ds/dl)>=0.1 are present by ≥ 80% in all the crystal grains, and having a duplex steel structure consisting of ferrite by ≥ 80%, and the balance bainite.

JP '190 relates to a high strength hot rolled steel sheet having excellent hole expandability and ductility containing, in mass %, C : 0.01 to 0.08%, Si: 0.3 to 1.5%, Mn: 0.5 to 2.5%, P: 0.03% or below, S: 0.005% or below, and at least one of Ti: 0.01 to 0.2% and Nb: 0.01 to 0.04%, the balance consisting of iron and unavoidable impurities is hot-rolled into a steel sheet with a ferrite-bainite duplex steel structure in which the ratio of ferrite with a grain size of ≥ 2 μu m is ≥ 80%.

Thus, in contrast to the present invention, JP '188, JP '189, and JP '190 disclose a ferrite-bainite duplex steel structure comprised of ferrite of not less than 80% with the remainder bainite (*see*, *e.g.*, para. 0017 of JP '188, JP '189, and JP '190; see also corresponding US patent publication no. 2004/035508, Abstract; "US '508," submitted in a Supplemental Information Disclosure Statement filed concurrently herewith). This is different from the present invention wherein the strength and hole expandability is improved by precipitation strengthening of a *ferrite* structure.

Furthermore, JP '188, JP '189, and JP '190 each state that a ferrite cannot be sufficiently deposited when the air cooling time is less than 2 seconds (*see*, *e.g.*, para. 0020 of JP '188, JP '189, and JP '190; see also US '508, paragraph [0054]). This is different from the

present invention, where as stated above, it is necessary for the air cooling time to be within 0.8 seconds so that the tensile strength of at least 1049 $N/mm^2$ can be consistently obtained.

In addition, JP '188 discloses a steel having a maximum tensile strength of 988 $N/mm^2$ (*see*, Example 8 in Table 2 of JP '188), JP '189 discloses a steel having a maximum tensile strength of 984 $N/mm^2$ (*see*, Example 5 in Table 2 of JP '189), and JP '190 discloses a steel having a maximum tensile strength of 976 $N/mm^2$ (*see*, Example 7 in Table 2 of JP '190). See also US '508, Tables A2, B2, and C2. These strengths are much lower than the strengths of the present invention (*i.e.*, at least 1049 $N/mm^2$).

Moreover, in the present invention, Al and Nb are indispensable elements. Al is necessary to suppress the formation of detrimental carbides and to promote the ferrite formation so that both strength and ductility can be satisfied. Nb is necessary to secure strength through NbC precipitation (*see*, the specification at, *e.g.*, p. 5, l. 31 through p. 6, l. 4; and p. 6, ll. 22-29 ). In JP '188, JP '189, and JP '190, however, none of the Examples contain Al, and Nb is an optional element (*see*, Table 1 of JP '188, JP '189, and JP '190; see also US '508 Tables A1, B1, and C1).

EP '003 does not cure these deficiencies. EP '003 relates to a method of producing steel having a low yield ratio consisting essentially, by weight, of: C: 0.30% or less, Si: 0.05 to 0.60%, Mn: 0.5 to 2.5%, Al: 0.01 to 0.10% as the basic components, with the balance being iron and unavoidable impurities, to a temperature of 950° to 1250° C, hot rolling it, quenching it to a temperature not exceeding 250° C, reheating it to a temperature of $Ac_1$ +20° C. to $Ac_1$ +80° C, water-cooling it and then tempering it at a temperature range of 200° to 600° C, whereby the steel is given a two-phase mixed microstructure of ferrite and second-phase carbide.

In EP '003, for example, the maximum tensile strength of the steel is 813 $N/mm^2$ (*see*, Table 4, Steel No. v1 of EP '003), which is much lower than the strengths of the present invention (*i.e.*, at least 1049 $N/mm^2$). In addition, in EP '003, the range of the Si content is 0.05 to 0.60% which is outside the range of the present invention of 1.2 to 1.5%. Furthermore, EP '003 does not disclose air cooling for 0.5 to 0.8 seconds.

Therefore, JP '188, JP '189, and JP '190 in view of EP '003 provide no reason for one of ordinary skill in the art to seek the presently claimed steel product, and the present claims are not obvious over JP '188, JP '189, and JP '190 in view of EP '003. Accordingly, the rejection of claims 1 and 2 under 35 U.S.C. §103(a) as obvious over JP '188, JP '189, and JP '190 in view of EP '003 cannot stand, and should be withdrawn.

## Conclusion

Applicants thus submit that the entire application is now in condition for allowance, an early notice of which would be appreciated. Should the Examiner not agree with Applicants' position, a personal or telephonic interview is respectfully requested to discuss any remaining issues prior to the issuance of a further Office Action, and to expedite the allowance of the application.

Respectfully submitted,

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Dated: May 24, 2010

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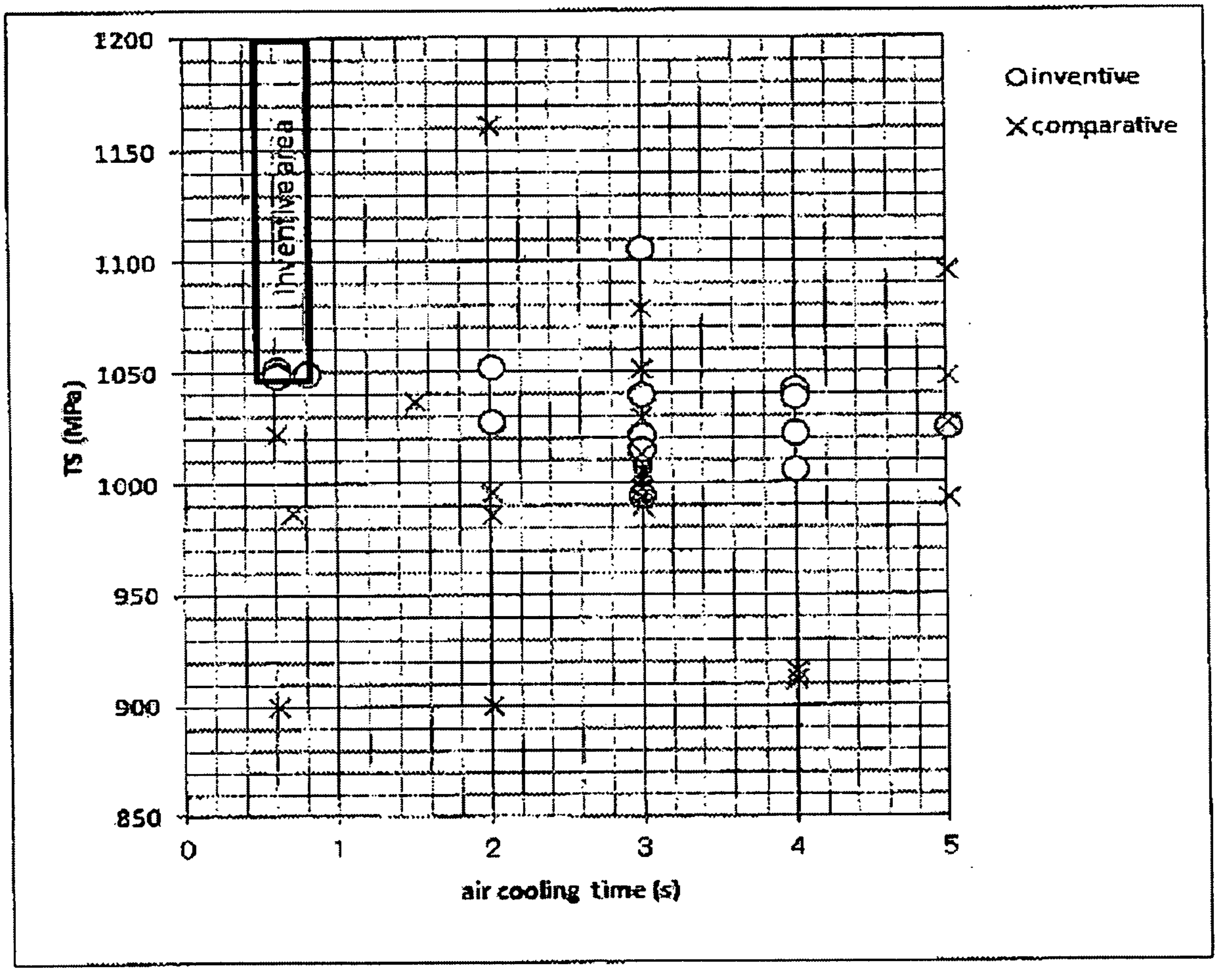
Encl.

**Exhibit A**

Reference Figure 1



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